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Review Report

Herbal Mouthwash in Animals: A Review

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ABSTRACT

Dental plaque and periodontal diseases are prevalent concerns in humans and animals. Traditional treatments, such as chlorhexidine mouthwash and systemic antibiotics, are limited by issues including tooth staining and antibiotic resistance. Therefore, herbal alternatives have gained interest for their antibacterial, anti-inflammatory, and plaque-inhibiting properties. The present study assessed the efficacy of natural mouthwashes derived from green tea (*Camellia sinensis*), guava (*Psidium guajava*), propolis, pomegranate (*Punica granatum*), neem (*Azadirachta indica*), and miswak (*Salvadora persica*) in promoting oral hygiene as an alternative to conventional antibacterial agents in humans and animals. Several studies have indicated that these natural plants exhibit significant antimicrobial activity, reduce plaque formation, and alleviate gum inflammation without adverse effects. Green tea catechins, guava tannins, propolis flavonoids, pomegranate polyphenols, neem extract, and Miswak extract have shown promising results in dental care for both humans and animals. Herbal mouthwashes provide a safe and effective alternative to traditional oral hygiene products such as chlorhexidine.

1. Introduction

A mouthwash is a therapeutic liquid that stays in the mouth, mixing with saliva and the movement of the surrounding muscles to eradicate oral pathogens[1]. Inflammation and recession of the perialveolar gum margins are frequently observed in both dogs and cats[2]. These conditions primarily arise from an excessive accumulation of dental plaque, which results from the by-products of food and saliva decomposition by the normal oral bacterial microflora[3]. Dental plaque comprises an organic matrix constituted by salivary glycoproteins and polysaccharides that adhere to the tooth surface, thereby establishing an environment conducive to the proliferation of oral microorganisms bacteria[4]. Implementing adjunctive management strategies, such as providing hard food, regular tooth brushing, and oral hygiene chews, has been demonstrated to decrease the occurrence of calculus formation[5]. There are several treatment options, including removing severely damaged teeth, cleaning out dead or overgrown gum tissue, smoothing the roots of teeth with curettes, and removing tartar from the remaining affected surfaces above and below the gum line using manual or ultrasonic methods in animals and humans[6]. Additionally, daily flushing of dental surfaces with antibacterial agents, such as 0.1% to 0.2% chlorhexidine, or brushing every other day, may help to slow the accumulation of calculus. However, it is essential to note that chlorhexidine can cause a light blue discoloration of the teeth and may also contribute to the re-accumulation of plaque[7]. Systemic antimicrobials, including tetracycline, metronidazole, and tinidazole, along with topical chlorhexidine, have been assessed for their efficacy in treating periodontitis in dogs subjected to experimental conditions[8]. The application of antibiotics and chemical agents can lead to irreversible consequences for both animal and human health[2]. Consequently, numerous studies have been undertaken to investigate the potential of herbal mouthwashes in human subjects[9]. Considering these challenges, there is increasing interest in herbal alternatives for oral care, which provide antimicrobial, anti-inflammatory, and antioxidant benefits with fewer side effects. Natural compounds derived from plants such as green tea (*Camellia sinensis*)[10], guava (*Psidium guajava*)[11], propolis[12], pomegranate (*Punica granatum*)[13], neem (*Azadirachta indica*)[14], and Miswak (*Salvadora persica*)[15] have demonstrated significant impacts in reducing plaque formation, blocking bacterial adhesion, and easing gum inflammation. These botanicals

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contain bioactive compounds, such as tannins, polyphenols, flavonoids, and alkaloids, that inhibit microbial growth and improve oral health (Figure 1)[16,17]. The present study aimed to explore the efficacy of herbal mouthwashes as an alternative to conventional antibacterial agents for controlling oral pathogens and periodontal disease in humans and animals, focusing on their antimicrobial and antiplaque properties to improve oral health.

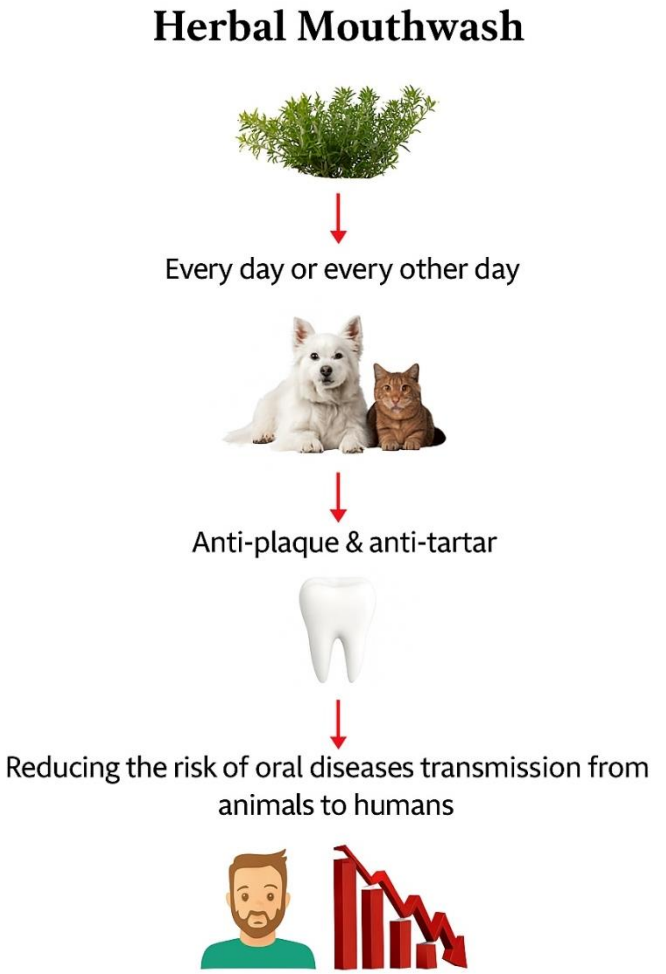

Figure 1. Effects of herbal mouthwashes on animals and human oral health.

2. Green tea

The impact of green tea (*Camellia sinensis*) on preventing oral bacterial infections, halitosis, and dental plaque formation was specifically examined. A group of twenty-five female volunteers, aged between 20 and 25 years, participated in a study, which evaluated green tea extract and mouthwashes containing 0.2%, 0.5%, and 1% tannin, recognized as the most efficacious antibacterial component in green tea[18]. Herbal extracts have been widely used in both topical and oral treatments for different diseases in humans and animals[10]. Green tea, which does not undergo fermentation during its drying process, provides numerous medicinal benefits primarily attributed to its antioxidant and antibacterial traits. Among the phenolic phytochemicals that exhibit beneficial properties for the health of both humans and animals, a notable group is the polyphenol compounds known as Catechins, which are present in green tea[19]. A study by Sakthivel et al.[20] indicated that animals and humans consuming tea-infused water experience a reduction in dental caries and plaque accumulation compared to those who drink plain water.

3. Guava

In southern Nigeria, twigs are commonly employed as chew sticks, which are effective due to the bioactive compounds such as saponins, tannins, flavonoids, and alkaloids. These chewing sticks demonstrate high efficacy, reliability, and efficiency in maintaining dental hygiene even without using toothpaste. Users of these chewing sticks usually demonstrate robust, hygienic, and fresh teeth, free from dental plaque caries[21].

In Brazil, guava (*Psidium guajava*) is recognized for its astringent and diuretic properties, serving similar purposes as in Peru[22]. A decoction of guava is recommended as a gargle for conditions such as sore throats, laryngitis, and oral problems swelling[11]. Using chewing sticks without toothpaste remains a reliable way for many people in Southern Nigeria to keep their oral health[21]. These findings supported the hypothesis that the tea has prophylactic and protective effects against dental caries and plaque accumulation, as evidenced by the examined samples. In Ghana and Nigeria, people often chew leaves to treat toothaches, while a decoction made from the root bark is recommended as a mouthwash for swollen gums. Additionally, a decoction of the leaves is an effective gargle for swollen gums, oral ulcers, and bleeding gums[21].

Multiple studies have confirmed that guava extracts are effective against bacteria vital to both oral and overall health in animals. A study conducted by Biswas et al.[23] demonstrated that guava leaf extract exhibited potent antibacterial activity against *Staphylococcus intermedius* and *Escherichia coli* (*E. coli*), providing a scientific basis for using guava as a potential treatment against pathogens that colonize the oral cavity. Furthermore, Birdi et al.[24] indicated the efficacy of guava extract against a broad spectrum of pathogens, including *Salmonella* spp. and *E. coli*. This broad-spectrum antimicrobial activity is directly relevant to preventing oral infections and reducing the bacterial load that leads to plaque and gingivitis[24].

4. Propolis

Bee propolis is effective against several dental issues, such as plaque, cavities, gum disease, and mouth ulcers, and also provides other health benefits. The combination of propolis with toothpaste facilitates the prevention of periodontal disease, functioning as an anti-plaque and anti-inflammatory agent. Furthermore, bee propolis can also serve as a dental adhesive anaesthetic[12].

It has been concluded that propolis not only aids in repairing surgical wounds but also offers pain relief and demonstrates anti-inflammatory properties effects[25]. A laboratory investigation utilizing saliva samples from twenty-five healthy subjects and twenty-five patients diagnosed with chronic periodontitis revealed a significant suppression of microbial proliferation by propolis in both groups[26].

A study conducted by Saeed et al.[27] provided compelling evidence from live animals, indicating the mechanisms of propolis within the oral cavity. The findings of Saeed et al.[27] demonstrated that the well-documented antimicrobial and anti-inflammatory properties of propolis, which specifically target oral pathogens and gingivitis, are sufficiently effective to improve health outcomes and modulate the immune system within complex biological environments. Furthermore, its effective use as a natural substitute for antibiotics in poultry supports its safety profile and its inclusion in oral care products to maintain the oral health microbiome[27].

5. Pomegranate (*Punica granatum*)

Pomegranate is increasingly recognized for its important role in dental health. Clinical studies have shown that this well-known antioxidant effectively targets the biochemical causes of tooth decay with notable strength[13]. Using pomegranate mouthwash regularly along with toothpaste that contains bioactive botanical extracts may help reduce dental plaque and tartar by preventing the growth of microorganisms that lead to plaque formation[28]. Additionally, the compounds in pomegranate have anti-inflammatory effects that can reduce irritation in the mouth tissues[29]. Recent studies have demonstrated that pomegranate extract possesses the capacity to inhibit the adherence of specific microorganisms to dental surfaces[29,30]. This phenomenon appears to be primarily attributed to its action against a prominent species of *Streptococcus* (*S.*)[31], which disrupts the production of metabolites conducive to the proliferation of fungi and other microorganisms. These findings underscored the potential of pomegranate extract as a beneficial agent in dental health by mitigating the risk of microbial colonization[31,32]. Plaque formation typically involves the collaborative action of different microorganisms that colonize dental surfaces[3]. Notably, pomegranate has been shown to hinder the adhesion of oral microorganisms by interfering with the synthesis of the adhesive substances produced by bacteria[13]. Several studies have noted that the active compounds of pomegranate, including polyphenolic flavonoids such as punicalagin and ellagic acid, are believed to reduce gingivitis via different mechanisms, including diminishing oxidative stress within the oral cavity, exhibiting direct antioxidant activity, exerting anti-inflammatory effects, possessing antibacterial properties, and facilitating the direct removal of plaque from teeth[32,33]. Clinical findings suggested pomegranate extract may ameliorate clinical markers of chronic periodontitis, as demonstrated by a pilot study reporting significant reductions in probing depth and gingival inflammation[34]. A study at Ohio State University performed a randomized, double-blind trial with 32 healthy young adults[32]. These findings were further supported by showing significant improvements in oral antioxidant capacity and inflammatory markers after pomegranate extract supplementation.

6. Neem

The earliest documented use of neem (*Azadirachta indica*) by the Harappan civilization in ancient India dates back approximately 4,500 years[35]. The neem tree plays a significant role, deeply rooted in the cultural and historical fabric of Indian society. Its enduring presence demonstrated both its ecological and socio-cultural significance throughout the region[35].

In contemporary studies and practices, neem extract is known for its multifaceted applications in dermatological therapies, demonstrating efficacy as an antiseptic and exhibiting anti-parasitic properties effective against both endoparasites and ectoparasites[36]. Furthermore, neem extracts are used in making herbal mouthwashes, underscoring their role in oral health. The widespread use of neem extract underscores its importance in both traditional and modern medicine[37]. Additionally, neem extract is known for its non-toxic, insecticide, and pesticide effects[38-40]. Although the antibacterial properties of neem have been well-researched, recent studies mainly focus on its emerging therapeutic uses and molecular actions, with its antimicrobial effects only briefly mentioned and discussed[40]. *In vitro* studies have demonstrated that neem exhibits strong antibacterial properties against both Gram-positive and Gram-negative bacteria, including *E. coli*, *Streptococcus*, and *Salmonella,* which cause different human and animal diseases[36,37,40,41].

Recent studies have focused particularly on oral health, a significant issue in both developing countries with limited access to dental care and in developed countries with aging populations[42]. Substances from neem sticks or bark have been found to slow the growth of *S. mutans* bacteria[43]. The findings of Wolinsky et al.[14] have indicated the inhibitory effects of aqueous extracts derived from neem sticks on bacterial aggregation, growth, adhesion to hydroxyapatite, and the production of insoluble glucan, which may impact plaque formation *in vitro*. The neem stick extract, combined with a gallotannin-rich extract from Melaphis chinensis, has been shown to inhibit the production of insoluble glucan[14]. When oral streptococci were incubated with the neem stick extract, bacterial colonies were observed under a microscope[14,44]. These findings suggested that neem stick extract may reduce the ability of certain streptococci to adhere to tooth surfaces[14,45]. The promising effectiveness of *Azadirachta indica* in dental treatments was mainly supported by human research. Nevertheless, its antibacterial and anti-inflammatory effects against prevalent oral pathogens are directly relevant to veterinary applications; therefore, utilizing neem in veterinary dentistry constitutes a logical and evidence-based progression from its use in human medicine research[45].

The study of El-Deen et al.[46] provided essential *in vivo* evidence of neem's broader biological effects, supporting its role in oral health. The findings of El-Deen et al.[46] demonstrated that neem can boost immune function, reduce oxidative stress, and combat pathogens in a complex living system. The study emphasized the potential of neem to improve oral health by reducing gum inflammation, regulating oral pathogens, and supporting mucosal health immunity. These findings confirmed neem's antibacterial, anti-inflammatory, and immunomodulatory properties, establishing it as a promising candidate for the prevention

and management of dental plaque, gingivitis, and other oral diseases in animals[46].

7. Miswak

Salvadora persica, also known as miswak, is a medicinal plant with roots that have been used by people in Africa, South America, the Middle East, and Asia for centuries[47]. The Babylonians, dating back to 5000 B.C., documented the specific method for using miswak, and this practice later spread to the Greek and Roman empires[48]. The alcoholic extract of miswak exhibited notable *in vitro* antibacterial efficacy at a concentration of 10 mg/mL, with studies affirming its safety and tolerability[49]. *Salvadora persica*, when used as a mouthwash, exhibits superior plaque-inhibiting properties in comparison to a placebo; however, it is less effective than chlorhexidine in clinical settings[47].

Animal studies have been crucial in confirming the traditional uses of miswak and elucidating its role in enhancing oral health[50]. In one study, rats infected with *S. mutans* and fed a high-sugar diet developed far fewer carious lesions when their drinking water was supplemented with miswak extract compared to the control group, emphasizing its strong antibacterial effect against the main bacterium responsible for tooth decay[51]. Studies in rats have shown that miswak extract significantly lowers the occurrence of dental caries[50,51]. Utilizing rat models of periodontitis has demonstrated that miswak exhibits potent anti-inflammatory properties that safeguard the periodontal tissues and supporting alveolar bone[50]. The analgesic potential of miswak, which explains its traditional use for toothaches, has been confirmed in animal models[52]. Sofrata et al.[53] conducted a study on the methanolic extract of *Salvadora persica* roots in mice using the formalin-induced pain test, finding that Miswak significantly reduced pain responses, indicating a central pain-relieving effect similar to that of some analgesic medicines[53].

8. Conclusion

The increasing occurrence of oral diseases in humans and animals highlighted the need for developing effective and safe preventive measures. Although chemical mouthwashes such as chlorhexidine are still widely used, their adverse effects highlighted the need for natural alternatives. Herbal mouthwashes derived from green tea, guava, propolis, pomegranate, neem, and miswak offer potent antimicrobial, antiplaque, and anti-inflammatory benefits. The components of these botanicals function through multiple mechanisms, including inhibiting bacterial adhesion, reducing oxidative stress, and promoting periodontal health, without the disadvantages of traditional treatments. Clinical and laboratory studies supported their efficacy in reducing plaque, preventing caries, and managing periodontal diseases. Incorporating these herbal solutions into daily oral care routines could enhance dental hygiene while minimizing risks. Nevertheless, the current evidence underscored the potential of herbal mouthwashes as sustainable, safe, and practical tools for maintaining oral health in both humans and animals. Further research, particularly long-term clinical trials in veterinary medicine, is warranted to optimize formulations and dosages of these herbal mouthwashes.

Declarations

Competing interests

The Authors declared no conflict of interest.

Authors' contributions

Faezeh Salari-Kakhk developed the concept, curated the data, conducted the investigation, supervised the study, and validated the findings. Seyed Amin Razavi and Rafat SASANY contributed to data curation, investigation, validation, and manuscript writing, helped with review and editing, and wrote the initial manuscript. All authors reviewed and approved the final edition of the manuscript for publication.

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Availability of data and materials

The data supporting the present study are available upon reasonable request from the corresponding author.

Ethical considerations

The authors have comprehensively reviewed the manuscript to ensure adherence to ethical standards, addressing issues such as plagiarism, research integrity, data falsification or distortion, and redundant publication.

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